

## Editorial

This issue of *Zygon* consists of a series of papers whose focus is the thought of David Bohm. As many *Zygon* readers well know, Bohm is a theoretical physicist whose pioneering research in the early 1950s produced a new interpretation of quantum mechanics in terms of nonlocal hidden variables. Recently his analysis of the deeper conceptual problems of modern physics has led him to reject mechanism in favor of a wholistic conception of nature. Moreover, Bohm's vision extends beyond physics into art, thought, language, philosophy, and religion. With compelling insight, Bohm urges us to overcome the fragmentation of self and world and regain a sense of unifying order which is implicit in all human experience.

*Zygon* readers will find Bohm's work engaging for a number of reasons. First, it is grounded in the natural sciences. Dozens of papers in theoretical and experimental physics have come from his work, and the prospect of continued research seems strong as his collaboration is extended from England to America. Second, it is philosophically attractive. As the first (and perhaps still the most promising) alternative to standard quantum mechanics, it keeps open the possibility of a realist interpretation of physics in the tradition of Albert Einstein. Because it is a nonlocal theory it maintains the theme of wholeness found in the conceptuality of Niels Bohr. In its extension to a new metaphysical structure, the implicate order, Bohm's approach is resonant with the philosophy of Alfred North Whitehead. Third, it is ripe for theological interpretation, since concepts such as cosmos, wholeness, fragmentation, and implicate order are extended as integrating metaphors to all of experience. Through it can come new language for God and human nature, for estrangement and community, for religious experience in contemporary culture. Bohm's work thus bridges physics, philosophy, theology, and the study of consciousness and language. It provides a framework within which many can come together for critical dialog, for mutual understanding, for creative growth.

The papers in this issue grew out of a conference entitled "David Bohm's Implicate Order: Physics and Theology" held in Berkeley, California in April, 1983. The conference was sponsored by the Center for Theology and the Natural Sciences, an affiliate of the Graduate Theological Union. The program of the Center includes research, courses, conferences, forums, and church seminars focused on the relationship of science, philosophy, theology, technology, and ethics. The Center supports a GTU faculty position, offers a fellowship for distinguished visiting scholars, and publishes the *CTNS Bulletin*.

On the first day of the conference, Bohm gave a public address on the development of his research and its implications for religion. His initial paper in this issue came out of that address. The next day, along with Bohm, scholars from the Graduate Theological Union, the University of California at Berkeley, the Center for Process Studies, and Notre Dame University presented and discussed several of their papers, four of which appear in revised form in this issue. Finally a recent response by Bohm to these papers is printed at the end of this issue. In addition we have included a second major essay by Bohm because of its direct relationship to the talk he gave in Berkeley.

Bohm's first essay starts with a fascinating retrospective reflection on the development of the main schools of thought in quantum physics, especially the

continuing debate between Einstein and Bohr, in which he was himself intimately involved. Bohm sided with Einstein's realist epistemology against Bohr's positivist interpretation; yet his "hidden variables" formalism did not imply the absolute determinism which Einstein defended. Bohm's theory was developed with great sophistication and its results were as good as (though not better than) previous formulations in terms of agreement with experiments. He traces here his increasing conviction that the whole must be seen as prior to the parts. He indicates why he used the hologram and the ink drop as examples of an "enfolded" or implicate order from which information can be "unfolded" into an explicate order of spatial and temporal relationships between discrete objects.

Bohm's clear summary of his scientific work should be understandable to any reader of *Zygon*, even though some of his assumptions diverge from those of most contemporary physicists. He emphasizes that the quantum potential reflects the whole environment, including distant events. He describes his recent work on quantum field theory and the idea of a "super-quantum potential" in which the features of nonlocality and nonlinearity are prominent. The last part of "Hidden Variables and the Implicate Order" elaborates some parallels between the implicate order in physics and the structure of human consciousness; for example, implicit meaning is made explicit in thought and language, and intention is unfolded in speech and action. He also raises the religious question about the ultimate ground from which the world unfolds, and concludes: "When I see the immense order of the universe (and especially the brain of man), I cannot escape feeling that this ground enfolds a supreme intelligence. Although it is not quite so evident, I would say also that this intelligence is permeated with compassion and love."

Bohm's second essay, "Fragmentation and Wholeness in Religion and in Science," based on a talk given at St. James's Church, Piccadilly, London in September, 1983, carries further the theme of wholeness in science and religion. Whereas Newtonian physics pictured a mechanistic world of separate particles, modern physics talks about continuous fields and the inseparability of observer and observed—though positivist scientists are content to use these theories as equations for making predictions, without reflecting on the nature of the world. Bohm decries this fragmentation of scientific and philosophical interests. Faith in science as a path to the unity of mankind, he suggests, has been undermined by the threat of nuclear and ecological destruction. Bohm sees the idea of the separate ego as the main source of contemporary fragmentation, and he states that the aim of religion is the transformation of the ego to end fragmentation. The words *holy* and *healing*, he notes, come from the same root as *whole*. Yet religion, too, has been a divisive force. Bohm presents us with the challenge of overcoming egotism by seeing ourselves as manifestations of a universal energy or intelligence.

Robert Russell's paper discusses Bohm's scientific theories and then considers their philosophical assumptions and theological implications. He reviews the continuing themes and the significant developments in Bohm's writings from 1952 to the present. What, he asks, is the current scientific status of Bohm's work? Using Imre Lakatos's criteria for a "progressive research program," he concludes that at the moment the assessment would have to be mixed. No results which are experimentally distinguishable from previous formulations have been developed or are expected at energies within reach of current or foreseeable accelerators. Yet Bohm's efforts to extend his analysis to

relativistic quantum mechanics and his new interest in time irreversibility and entropy could give new promise to his program.

In examining the philosophical dimensions of Bohm's writing, Russell looks particularly at the dominance of continuity over discontinuity and monistic over pluralistic assumptions. In his closing section he outlines a number of features of Bohm's outlook which are in harmony with the Judaeo-Christian tradition. The stress on wholeness, for example, is consonant with the biblical idea of the unity of creation. But Russell also raises some questions about the theological implications of Bohm's thought. Does the idea of order underlying nature lead to a Spinozistic concept of an impersonal God? How are cosmic order and cosmic purpose related? How are evil and suffering represented? Should we seek the dissolution of the self—or the healing of our brokenness through the restoration of relationships?

The paper by Geoffrey Chew explores some links between Bohm's work and his own graphical particle theory. Chew has had a distinguished career as a physicist; his S-matrix or "bootstrap" theory is known to a wider public because of its prominent place in Fritjof Capra's *The Tao of Physics*. (Both Bohm and Chew have commented on similarities between the wholism of their theories in physics and the wholism of Eastern religions, but they have not claimed an extended parallelism of the sort developed by Capra.) In his contribution to this symposium, Chew proposes that the explicate order of particles in space-time emerges from the emission and absorption of low-energy photons. He also suggests that "color" and other "hidden" variables in particle theory can be viewed as a kind of implicate order.

An illuminating comparison of Bohm's metaphysics with that of Whitehead is given in David Griffin's essay. He points to many striking similarities, including parallels between Bohm's vision of wholeness and Whitehead's idea that entities are internally rather than externally related to each other. But he also analyzes significant differences. For example, Whitehead allows for direct causal influences between events, whereas Bohm holds that events influence each other only via the whole. Griffin argues that human freedom, creative novelty, the irreversibility of time, and God's transcendence are all more adequately represented in Whitehead's framework than in Bohm's. Yet Griffin is on balance sympathetic with Bohm's project. He notes also that the idea of nonlocal correlations is compatible with what seems to be an instantaneous influence of distant events in the correlation of photon pairs (in the recent Bell's Theorem experiments), and perhaps in parapsychological phenomena such as mental telepathy.

In the final contribution, Ted Peters looks at Bohm's writing in the context of the search for wholeness in philosophy and theology. In contrast to Newtonian mechanism and Descartes' mind/matter dualism, Bohm takes mind and matter to be modes of one underlying reality. But in what sense, Peters asks, can the whole be present in the parts or life in inanimate matter? Bohm says that the inclusive multi-dimensional ground of the implicate order is creative, but he does not consider it divine. Peters sees this as consistent with the distinction between God and the created order in Christian thought. But he does find some tension between the biblical view of the importance of historical events and the way in which temporality and historicity tend to be swallowed up in the timeless unity of Bohm's implicate order. Peters also argues that biblical theology portrays an open future and anticipates an eschatological wholeness which does not yet exist.

Bohm's concluding commentary, along with the other papers in this issue, provides impressive evidence that interdisciplinary communication is difficult but not impossible in our fragmented world. Scientists, philosophers, and theologians really can learn from each other in their attempts to understand the world which we share.

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